WESTEX -2 and -3 Preliminary reports.

The WestCoast Conference on extra-terrestrial biology met for its second and third sessions respectively at the Jet Propulsion Laboratories, Pasadena, California (March 21, 1959) and at the Hopkins Marine Station, Stanford University, Pacific Grove, California, (May 2-3, 1959). The attendance at the two meetings was:

	2:	3:		2:	3:	
Calvin	+		Novick	+	+	
Stent	+	+	Krauskopf	+	*	*expressed doubt as to further active participation a/c pressure of other business.
Weaver	+	+	Van Niel	+	+	
Marr	+	+	Thomas	+	+	
Urey	+		Sagan		+	
Homowitz	+	+	Badger		+	
Davies	+	+	Lederberg	+	+	
Hibbs	+		Stanier		*	
Sinton	+		Bracewell		+	

The conference feels that the preparation of a detailed analytical report should be the first order of business during the next few months. This will be a challenging and time-consuming assignment. It hopes that Mr. Sagan will accept the assignment and that financial support for this (as a full time job for the summer months) will be available. Tape recordings of the sessions are available; Mr. Sagan might also visit the conferees individually. We are planning the next session for September to review the report , unless other urgent business comes up in the interim.

This paper is a brief resume of the matters considered during the two meetings.

A. CETEX -- Extraterrestrial contamination.

Minutes of Westex-1 were forwarded to Hughes and Odishaw for use during the Cetex meeting of March 9-10, 1959 at The Hague. We just missed receiving the Cetex report (since published in Nature, April 4, 1959) for review at the second meeting. At this and our third meeting, the conference emphatically reiterated the position adopted in the Westex-1 minutes. While the CETEX-2 report is an important contribution, we feel that it still does not adequately represent the interest of the biological sciences in space exploration policy, which we hope will be remedied in the further activities of COSPAR in this field. The aspects of the CETEX report to which we would particularly direct the attention of the Space Science Board are:

1). "The outside of space-vehicles need not be sterilized, since ... solar radiation during flight will destroy all microorganisms which have settled on the shell." We are informed that Pioneer IV, for example, was programmed to keep the lower part of the payload in complete darkness, for the purpose of actuating a trial shutter by moonlight. In any case, this assertion is based on the full exposure of naked microbes to insolation. If this condition can be assured, but only if so, we could rely on the sterilization of the outer shell by solar UV. Methods can, however, be developed to protect the inner payload from contamination during its transit through the earth's atmosphere.

2). "The need for sterilization is only temporary. Mars and possibly Venus need to remain uncontaminated only until study by manned space-ships becomes possible." We trust that this statement is intended to be interpreted: until we can better assess the possible consequences of planetary infection, at which time a sounder decision will become possible. It should also be stressed that a manned expedition could not fail to introduce massive biological contamination to its target.

3) "Panspermia....must be rejected because solar radiation (in a high vacuum) would decompose biospores just as it decomposes cosmic dust." We have repeatedly conceded the probable accuracy of this statement. However we cannot support the dogmatic exclusion of a hypothesis for which an experimental test is potentially available, and which would so profoundly influence our conceptions as to the nature of terrestrial life. We suggest the more conservative approach that the extra burdens placed on, e.g., lunar exploration by adherence to a strict policy of axenia be weighed in terms of the risks of meaningful contamination.

Our approach to this problem is conditioned by the expectation that strict decontamination does not pose an impossible task-- that it would in fact add an immeasurably small fraction to the cost of space missions (measured in time and effort as well as money).

4)"Contamination of Mars and Venus." The Conference applauds the forthright stand taken by CETEX : "It is therefore of the greatest importance that space-vehicles should not land either accidentall y or deliberately on Mars (and possibly also Venus) unless all precautions have been taken to exclude living organisms from them." We agree that these targets pose far more significant issues than those related to the moon and to the panspermia hypothesis. We urge the National Academy of Sciences to take all possible measures to encourage the adoption of this position by all agencies in the US and elsewhere engaged in space missions. We particularly urge that NASA be encouraged to adopt this aspect of the CETEX report as an encouragement to international adherence to it.

We hope that this section will be interpreted as tangible support a) for research on methods of decontamination and on the survival of microorganisms in extraterrestrial environments, and b) for the empirical testing of the precautions intended to exclude contaminants from space probes.

Some specific recommendations bearing on methods of decontamination are summarized in the Westex-I reports. We particularly urge that an effort be made to activate cooperative research on these problems, and especially recommend the Biological Warfare Laboratories at Fort Detrick, Maryland for the purpose. We also suggest the inclusion of marker substances in payload components to facilitate their identification as such by later explorations. For example, fluorinated hydrocarbons might be systematically incorporated in all plastic components; a rare or isotopically enriched metal agreed on as a standard marker in metallic components.

B. Methods of decontamination. These require further study in close liasionwith the operating missile laboratories. Different components may require different techniques for their internal sterilization, so that methods of treating the final package, e.g. gaseous fumigation, will be more effective. Machined parts and similar components are known to be liable to moderately heavy contamination; emulsified cutting oils are especially rich sources of this. Careful cleansing of parts is the most important measure; this can be fortified by the incorporation of antiseptic compounds into lubricating and cleaning oils, and by the use of bactericidal metals, e.g., silver, for plating. However, empirical tests are needed on a comprehensive scale to evaluate the residual contamination load of the assembled.

This question was discussed in some detail, especially with Dr. Davies from JPL.

In connection with accidental landings, further study would be desirable on design features that might ensure destruction of a payload during atmospheric reentry or on impact.

C. MARS program. Infra-red spectroscopy furnishes the most promising approach to the detection of characteristic chemical compounds (more accurately functional groups) at great distances. Sinton presented his observations on Mars made with the 200" reflector at Palomar. He reports 3 absorption bands at 3.43, 3.56 and 3.67 μ in addition to the atmospheric CH_4 band at 3.33 μ and others attributable to atmospheric H_2O. Other infra-red bands are unfortunately inacceible owing to the opacity of

the earth's atmosphere. The 3,43 μ band might be attributable to asymmetrical C-H stretch; the others to C-H stretch in molecules containing C-O bonds as well. The most plausible assigment of these bands would then be to complex organic molecules containing oxygen or nitrogen in addition to hydrogen and carbon.

However, the absorptions are relatively weak, even in the observations of the 'dark areas' of Mars. The 3.43-3.46 band which was most prominent in his first observations of the whole planet is the least discernible in the newer obaervations, and the marginal energies available make a detailed comparison of the spectra difficult to interpret. These observations are certainly the most exciting encouragement to the detection of Martian life, but require considerable amplification before their evidentiary value is settled. The following suggestions were discussed:

a) Repeated observations with the terrestrial telescope, especially to measure seasonal effects. Masking to get a clearer separation of light and dark areas might improve the sharpness of the spectra.

b) Observations from instruments above the atmosphere (balloons; earth satellites.)

Pertinent to the present conference was a strong recommendation to program a high resolution spectral scanning of a meridional diameter of the Martian disc from a probe, such as the Vega-developmental trials hoped-for in 1960-61. If possible, the spectrum from 1-10 μ whould be included. However, the solar energy available for reflection diminishes rapidly at longer wavelengths, and in the extremely interesting 6-8 μ region is far exceeded by the thermal emission of the planet. Further study is required to ascertain whether Mars would behave as a black body, or would show selective emission at wavelengths corresponding to its surface constitution.

To back up this project, extensive data on reflection spectra of candidate materials are badly needed, for comparison with the anticipated results from the probe. Marr (Davis), Calvin (Berkeley) and Thomas (SRI) have agreed to collaborate on exploratory work of this kind. Research funds should be made available to support the expenses of these as ongoing programs.

Characterization of organic material, including groupings such as C=O, $-CONH_2$; $-CH_2\phi H$ etc. would not, by itself, verify its biochemical origin, in view of the probability of photochemical syntheses. However, seasonal changes in extent might furnish contributory evidence of a global metabolism.

Jupiter was discussed by Carl Sagan as a likely site for the large scale operation of photochemical syntheses, accented by the gravitational sedimentation of heavier molecules out of the solar radiation field. He is seeking spectral evidence of such molecules in the Jovian atmosphere: several unidentified bands have already been described which he is seeking to correlate with model compounds in laboratory measurements. These involve specially long gas-path cells. This type of work should be extensively supported as the background to analytical discussions of the origin of life.

The detection of life by landing experiments, mainly by artificial culture, is mainly in a preliminary talking stage. While the heterotrophic metabolism of Martian biota might be very different from the earth's, we can make two optimistic predictions: a) that there will be autotrophic organisms (if any at all) adapted to the local environment as we find it, and b) in all likelihood there will be heterotrophic organisms that can metabolize simple organic compounds, such as glycine, which would be abundantly available by photochemical synthesis. Automated culture experimentsshould be designed on these bases.